New findings may help preserve rare Gutenberg Bibles

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Known as the first books to be produced using movable type, the Gutenberg Bibles are also famous for their colorful illustrations. But the exact composition of these 15th century painted images, which depict animals, flowers, fruit and other decorative figures, has remained a mystery, until now.

Using non-invasive analytical techniques, a team of researchers in England say they have for the first time precisely identified the pigments used to illustrate seven Gutenberg Bibles located in Europe. The findings provide chemical data that could ultimately help preserve and restore these rare historic treasures as well as provide insights into the printing practices of early Europe, they say.

The study will be described in the June 1 print issue of the American Chemical Society's Analytical Chemistry, a peer-reviewed journal. ACS is the world's largest scientific society.

"This spectroscopic chemical analysis of the pigments represents an important first step in an appropriate conservation and preservation strategy," says study co-author Gregory D. Smith, Ph.D., formerly with University College London and now a professor of conservation science at Buffalo State College in New York. Some chemicals used to conserve artifacts are appropriate for some materials but not others, Smith adds. "If you don't know the chemical composition of an artifact, such as a manuscript, then you have the potential to damage it by using the wrong chemicals to restore it or exposing it to the wrong environment when trying to preserve it."

Johann Gutenberg is credited with inventing movable metal type in the mid 15th century, an invention that has had a profound impact on Western culture by allowing the mass production of books for the first time. Prior to the invention, books were copied by hand. The German printer produced approximately 180 Bibles in Latin, of which 48 are known to survive today in collections throughout the world.

Although the Gutenberg Bibles are not believed to be currently deteriorating, their age — at approximately 600 years — makes it important that as much knowledge as possible is at hand if conservation is needed in the future, says study leader Robin J.H. Clark, Ph.D., a chemistry professor at University College London.

"We would like to have these historic manuscripts preserved indefinitely," Clark adds. Knowledge of pigments also may be used to indicate alterations that were made to the original documents, findings which could reveal previous attempts at restoration, he says.

In the current study, Clark's research team used Raman spectroscopy to analyze the pigments found in artwork from selected pages of the King George III copy of the Gutenberg Bible, located at the British Library. The researchers also analyzed flakes of leftover pigments found in the gutters (inner margins) of the books.

Raman spectroscopy involves shining a tiny laser onto a sample and analyzing the resulting light patterns, or spectra, using a sensitive detector. The spectra collected were then compared to those in a library of spectroscopic data obtained from known reference samples and also to spectra obtained from six other copies of the Gutenberg Bible located in other parts of Europe.

Researchers have known for some time, based on visual inspection of the King George III illustrations, that the pigments have nine main colors, but they have mostly speculated about the chemical composition of the pigments. Spectroscopy has now revealed for the first time the exact chemical composition. The bright red is cinnabar or its synthetic equivalent vermilion; yellow is lead tin yellow (Pb_2SnO_4); black is carbon; blue is azurite,

a basic copper carbonate; white is calcium carbonate (chalk); olive green is malachite (another basic copper carbonate); dark green is verdigris (copper ethanoate).

The researchers had difficulty obtaining the spectral data from the two other main pigments, gold and dark red. Based on other analytical evidence, they believe that the former is gold metal and the latter is likely to be an organic pigment obtained from plants or insects. The red pigment is still under study to establish its composition, they say.

“What is surprising is that this core knowledge [of pigment composition] had not until now been established, bearing in mind the colossal amount of art-historical research, which has been carried out on Gutenberg Bibles over the past six centuries,” Clark says.

The pigments found on the King George III copy are similar to those found on the six other copies of the Bible, although the styles of their illustrations vary considerably, the researchers say. The findings illustrate the comparatively limited number of pigments that were available for use in the 15th century across Europe and also show the high level of cultural integration of artistic practices that had taken place by then, Clark says.

The researchers now believe that copies of the Bibles that had richer color palettes than that of the King George III copy may be an indication that they were intended for very wealthy owners. Two German-held bibles both contain lazurite, an expensive mineral that is notably absent from the King George III copy.

One of the German copies contained anatase and rutile, compounds that are present only in modern paints. The presence of these materials is most likely to have come from external contamination or restoration work, Clark says.

Source: American Chemical Society